Unit computer pitfalls

by Capt. Peter M. Murphy

Part II

In the first part of this article, I addressed some of the many headaches and liabilities that face those who purchase a home computer for use in an Army unit. The purpose was not to discourage the acquisition or use of computers, but rather to caution the military against an uninformed and impetuous embracement of automation.

This part of the article assumes that the decision to acquire a computer has been made and therefore will offer guidance in the selection of the best personal computer.

Disclaimer

If the reader expects me to single out a specific computer by make and model, then this article will be a severe disappointment. It is not possible to recommend any one computer in this discussion for two reasons: it would be improper for me to endorse a particular product as that would give the impression that it has gained the approval of the US Army. It must be emphasized that any opinions expressed in this article are mine and do not necessarily represent official policy, thinking or endorsement by any agency of the US Army.

With the multitude of microcomputers already on the market (there are over 300 companies which offer a computer in the $1000 to $5000 range) and with new product announcements every day, a recommendation could well be meaningless by the time these words appear in print.

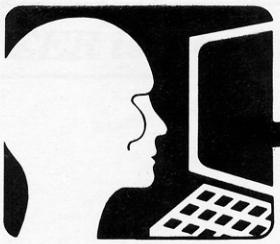
Rather than naming specific products, this article will describe the process for determining the ideal computer for each individual situation. Though most of the information and suggestions are general enough to have universal application, this article is tailored to address the needs of the Army, and the recommendations may not be appropriate for the average consumer.

Shopping for a computer can be bewildering

To those just beginning to explore the home computer market, the task of selecting just the right system out of the myriad of packages available seems rather difficult. As one travels deeper into the alien world of computer stores and learns about these technical marvels, it becomes apparent that the task which at first seemed "rather difficult" is actually closer to being down right impossible. Because of the endless options and technical specifications that a typical salesman will use to confuse the average consumer, some have likened the process of selecting a computer to purchasing an automobile or high quality stereo system. However, while there are similarities, buying either a car or a stereo is immensely simpler than choosing the right computer. The most common mistake made by consumers is to buy computers the way they buy cars and stereos. The process of shopping for computers is the reverse of the other two.

Program portability: a major obstacle

It would help to review one of the major obstacles mentioned in the first article: the lack of program portability. For a great number of reasons, the software which turns what would otherwise be a mass of dumb circuits into a seemingly intelligent and useful tool is very limited as to which computers it is compatible with. The first reason for this is that there are over a dozen different microprocessors being used by the many computer manufacturers. Each microprocessor has its own unique instruction set which determines what commands the computer is capable of understanding. Therefore,



any program written in machine language (the language of one of these microprocessors) cannot be executed on a computer which is based on a different microprocessor. Utilizing a high-level language such as BASIC or Pascal should solve this problem since a high-level language is theoretically machine independent. All that is required is either a compiler or an interpreter that can translate the high-level language that you are using into the machine language of your particular computer. This alone may be impairment enough as not all high-level languages are supported by all computers. To further frustrate the situation, most vendors fail to adhere to established standards and offer a slightly modified version of the popular high-level languages so as to make their computer more attractive. Any program that utilizes any of these non-standard extensions of the language thus loses its portability. Even when programmers restrict their code to the standard features of the language, cross utilization is not ensured for most computers come with their unique operating system. The operating system determines such things as how files (data and programs) will be stored on magnetic disk. Thus, two computers may use the same microprocessor and the same high-level language, yet if their operating systems format the disks differently, then they cannot easily share programs.

An analogy might be appropriate for illustrating the implications this has on the process of selecting computer hardware. Imagine that you were going to purchase a stereo system and that each stereo would only play certain types of record albums. Some systems may, for example, play only classical albums while others would accept only country and western music. Consumers would then have to decide what type of music they wanted to listen to and limit their shopping to only those systems that were compatible with that selection. Following this logic, it can be concluded that the proper way of buying a computer is to purchase the software you like first and then find the computer that it will run on. Though it may sound backwards, most computer professionals agree upon this strategy. This then defines the general philosophy for selecting a computer. The following is offered as a more detailed decision making process.

Four steps towards choosing the best microcomputer

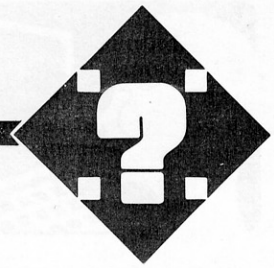
1. Define the application functions. Before any person or organization decides to buy a computer, they must answer the question, "what will the computer be used for?" In defining its applications, another more important question may be raised: "Is a computer really needed?" Some of the applications that have been identified in the Army include word processing, file and record keeping, computer assisted instruction (CAI), and decision analysis.

Using a microcomputer for CAI may mean developing actual lessons on the machine that not only teach a subject but are capable of automatically evaluating students and assisting them with problem areas. This type of CAI has been extensively developed at the Intelligence School at Fort Huachuca. Another valid form of CAI is through simulation training as with the Army Training Battle Simulation System which has been developed by the Combined Arms Training Developments Activity at Fort Leavenworth.

Decision analysis is a growing application of the computer in the military, the civilian business environment, and in the home. By distilling and presenting a mountain of information in molehill size where it can be easily understood and assimilated, the computer can render the decision making process less painful.

One of the most powerful applications developed for the small computers is information handling. This encompasses the file and record keeping that is required of the orderly room, a PLL clerk, unit supply, motor pool, the NBC Officer, the Property Book Officer, the TAMMS clerk, the armorer. The list could go on until every Army activity is mentioned. The programs that perform this kind of support are often called data base management systems. Communications interfacing or teleprocessing is another application with great importance to the military.

2. Identify software products which meet the specifications developed above. Once it has been well defined what the computer will be used for, start searching for software products that can be used in that application. There are many places to look for good software. A hit or miss method would be to peruse the various computer magazines. Even a visit to a local computer store may not be extremely fruitful if they do not carry a large selection of software (which is usually the case). There are several catalogs of software that have been published which not only categorize hundreds of quality programs by application, they also evaluate the software, list its price, and identify which company distributes it. Yet even this source has one major drawback: the products are not usually tailored to military applications. What the Army needs is a clearing house that will catalog programs written specifically with the Army in mind and will accept and distribute copies of programs that have been written by military personnel. There are three such organizations that provide this very service. Official responsibility for this activity rests with the Automation Management Office (AMO) within each major command. Each AMO should have available DA Pamphlet 18-1-1, Army Inventory of Data Systems (AIDS), which is a microfiche catalog of data systems currently in use or under development. This catalog is updated quarterly. Unfortunately, the AMO and the AIDS were originally intended to keep track of main frames and centralized data processing activities, and there may be little information available which pertains to microcomputers. There are, however, two organizations which maintain libraries of software written specifically for microcomputers used in the Army. They are the Command and Control Microcomputer Users' Group (C MUG) and the Automated Command and Training System Users' Group (ACTSUG). Both of these organizations will accept copies of programs and their documentation donated by the respective authors and in turn distribute copies of these programs free for the asking. All that is required is that the requestor provide a blank floppy diskette on which the software may be recorded and returned. Current catalogs may be obtained by writing to these organizations at the addresses which appear at



the end of this article. There are about 40 different programs available through these groups with many of the programs available through both.

3. Match the software products available to your own application requirements. Once appropriate software packages have been identified. The best ones should be selected. There are several guidelines to use in evaluating the products:

The software must be well written. This usually means by a professional software engineer or programmer. Though personal computers are so easy to use that anyone is capable of writing his or her own programs, this is not generally advisable even for a computer professional because of the time required to produce a truly professional product.

The package must be well documented. A program, no matter how powerful or professionally written, is of little value if the individual who wrote it is the only person who knows how to use it. Even with supporting documentation, unless it is well written and easily understood, the entire package diminishes in value. The program must be easy to use, even by someone who is unfamiliar with computers. This characteristic is known as "user friendliness." Most computer stores will allow a customer to use a program on a trial basis so that they may determine its ease of use.

Finally, the cost of the package must be considered. This cost should also cover support of the software product. A software house will frequently improve or update previously released programs and offer the newest version at a reduced cost to those who already own the product. This is definitely desirable, especially when the new version corrects an error that exists in the version you own.

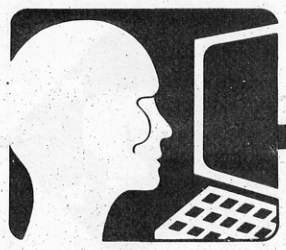
4. Define system requirements. The exact hardware requirements for a given computer system will be driven by the specific intended application. However, there are certain minimum hardware requirements that a serious computer user would desire. These requirements are generic and can be discussed without reference to specific manufacture. Many of these requirements will eliminate several manufactures and smaller priced computers from consideration.

Video Terminal: The video terminal consists of a display (usually referred to as a monitor or a "CRT" for cathode-ray tube) and a keyboard. Whether or not these two items are a single unit is unimportant. What is important is that the display (and the computer system) be capable of presenting a minimum of 80 characters per line and 24 lines per screen. The reason for this is that an 80 by 24 display has been an industry standard since the first days of digital computers and many programs assume this type of display. The second part of the terminal is a keyboard, and it should be a full ASCII keyboard. This means that it is capable of producing all 128 ASCII (American Standard Code for Information Interchange) codes. This implies that the keyboard will have a shift key (upper and lower case letters) and a "control key." A separate numeric keypad and cursor control keys are highly desirable.

Central Processing Unit (CPU): The heart of the computer which actually performs the calculations is the microprocessor or CPU. Which microprocessor the computer is based on will determine what instruction set the computer understands at the machine language or assembly language level. Therefore, the specific choice may depend on the choice of software and the choice of operating system which will be discussed later. There is considerable debate on whether an 8-bit or 16-bit (or even a 32-bit) microprocessor should be selected. The larger the word size the more data the computer can manipulate in a single operation. The word sizes are normally found in multiples of 8-bits. A computer system based on a 16-bit processor is capable of running significantly faster than an 8-bit processor. For most applications of microcomputers, the speed of the processor will not prove to be the limiting factor; rather, the limiting factor will be the peripherals such as disk drives, printers, and modems. Thus, one should not be swayed by arguments of increased speed in selecting a CPU, but should go with the one that will support the chosen software.

Memory: The main memory (sometimes called "core" — a term which has its origins in some ancient technology) is where both the program and data reside for execution. Main memory is also referred to as random access memory (RAM) and is measured in units of 1024 words (abbreviated as 1K) where a word is either 8-, 16-, or 32-bits as appropriate for the chosen microprocessor. Hence, the term 64K refers to 65 536 words of memory (64 x 1024). Many programs specify a minimum memory requirement of between 48K and 56K. The only caution is that the specifications can be misleading. A computer may boast 64K capacity without mentioning that 16K is used up by the operating system which is resident in memory at all times, another 8K is used to control the video display, and 2K is reserved for special system functions. This leaves the program with only 38K of transient program area (TPA). Thus, a true comparison of two computer systems must be made on their TPA size.

Disk Drives: Disks and diskettes come in a variety of sizes and styles for the microcomputer. For many applications, a rigid disk drive (while providing significant advantages in speed and total capacity) is an unwarranted expense (usually as much as the rest of the computer hardware put together). For serious computing, a minimum of one and sometimes two floppy disk drives are required for loading both programs and data into the computer system. Two drives are recommended because a system that does NOT store the data on the same disk as the program is much more flexible. Though there are a number of sizes of floppy disks available today, only two are in high use: 8 inches and 5 1/4 inches. Besides different sizes, disks also come in different formats. Each disk is divided into tracks (concentric rings of data), and each track is subdivided into sectors (usually between 10 and 32). A hard sectored disk is one that has as many timing holes punched in the disk as there are sectors. Obviously, the holes cannot be moved, and therefore this type of disk cannot be formatted to a different number of sectors. A soft sectored disk is one that is magnetically formatted and can be reformatted at any time. In addition, disk drives are divided according to their ability to



record on both sides of the disk or not (single sided vs double sided) and according to how compact the data can be recorded (single density vs double density). More data may be stored on a double sided, double density (DSDD) drive than a single sided, single density (SSSD) drive. The advantages of the 5 1/4 inch drives obviously includes physical dimensions, to some extent cost, and certainly there seem to be more vendors offering the smaller drives. The advantages of the 8 inch drives are speed and capacity. However, these advantages are insignificant compared to the greater advantage of transportability of software between 8 inch drives. While there is a standard SSSD format for the 8 inch disks, which all 8 inch drives are capable of reading regardless of their maximum density format, there is no widely used standard format for the 5 1/4 inch drives which would allow software to be transported from one system to another. However, the choice of available software must dictate which type of floppy will be used.

storage capacity (megabytes)*
5 1/4" drives — 3 to 50
8" drives — 10 to 200
average access time (milliseconds)
5 1/4" drives — 30 to 175
8" drives — 20 to 85
***one megabyte is approximately equivalent to 500 pages of text**

Printer: For most of the applications mentioned above, a printer is more than just a convenience. Selecting a suitable printer can be as confusing as the computer itself. Unless the computer will be primarily used for word processing and the preparation of outside correspondence, the expense of a letter quality printer would not be justified. The speed of the printer, which could range from 10 to 200 characters per second (CPS), would have to be sufficient to handle the expected printing requirements of the organization. A faster printer usually means a higher price. Finally, if you expect to generate a variety of reports, then at sometime you will discover the need for a 132 column report format. This can be accomplished by purchasing a printer with a wide carriage or one that is capable of compressing 132 columns into 8 1/2 inches.

Operating System: Though the operating system is not hardware, it is probably the most important system characteristic and may frequently limit choices on several of the above items. The operating system is the software (sometimes more than one program) which resides in main memory at all times and controls the operation of the computer system. This program performs the interfacing with peripheral devices and determines how files are formatted on the disk; it even determines how the user interacts with the system. There is no universal standard in operating systems, and the tremendous problem of program portability, which was discussed earlier is the result. There are several operating systems which have become pseudo standards simply by their proliferation if not by their popularity. Some are specific to a single computer while others are more transportable. Those that are proliferic within the Army will be dealt with here. The list is presented in no particular order.

Apple DOS 3.3: The disk operating system (DOS) used by the Apple II computer has gained wide acceptance and support by the shear number of systems that have been sold. Apple computer now enjoys a 21% share of the business computer market, and the Apple Computer has found its way into the Army in large numbers. Most of the software that is now available through the libraries at C MUG and ACTSUG are Apple compatible. MICROFIX is an example of a TEMPEST-engineered tactical computer system that has been developed for the Army and is based on the Apple II+ microcomputer. In addition, the Staff Planning and Decision Support (SPADS) system, the Target Analysis and Planning (TAP) system, and a microcomputer based battalion/squadron training simulation system (called MACE) all use the Apple II.

CP/M: The CP/M (Control Program for Microcomputers) operating system is a product of Digital Research, Inc. which was developed in 1975. Today, there are approximately 1.2 million systems that are CP/M compatible. The great attraction of CP/M is that it does not belong to one computer manufacturer and can be used on any system that has or can emulate the Intel I8080 microprocessor. This also includes the popular Z-80 and I8085 processors. CP/M will run on systems ranging from the Sinclair ZX-81 to the Digital Equipment Corporation (DEC) VAX minicomputer. It also can be made to run on computers from companies which produce their own operating systems such as IBM, XEROX, Radio Shack, Apple, Commodore, Heath/Zenith, Lexitron Datapoint, Burroughs Monroe, Wang, Osborne DEC, and others. There are at least 8 variations on CP/M including the CP/M-86, which is designed for use with the 16-bit I8086 microprocessor. However, software is not transportable between CP/M and CP/M-86. Another strong feature of CP/M is the fact that there are thousands of commercial software packages written for CP/M. Additionally, there are a significant number of public domain programs which are available free. Between the CP/M users Group (CPMUG) and the Special Interest Group in Microcomputers, (SIG/M) there are roughly 3900 public domain programs which will run on any CP/M system. For further information on how to get in touch with either one of these groups and obtain catalogs of their software, contact C MUG.

MS DOS: The Microsoft Disk Operating System is the trademarked system that is employed on the IBM Personal Computer. It is also known as PC DOS as it has been somewhat modified for the IBM PC. MS DOS seems to be easier to use for the novice than CP/M. What may be more important to those contemplating purchasing a computer is that the IBM name has made it possible for the IBM PC to assume commanding 26% share of the business computer market. Because of the large numbers of this micro and IBM work-alikes, it is destined to be a major factor in shaping future standards in microcomputing.

UCSD p-System: The University of California San Diego p-System refers to both an operating system and a method for transporting software that has been "compiled" into machine language between systems with completely incompatible processors. The way this is accomplished is by defining

a universal machine language or pseudo-code (p-code). When a program is compiled, instead of being translated into the machine language of that particular computer (native language), it is translated into p-code. Now this "compiled" program can be run on any computer that has the UCSD p-System and a p-code interpreter which will translate the p-code into native language. Thus, a program may be written and compiled on an Apple and then run directly on an IBM PC without reformatting so long as both use the UCSD p-System.

UNIX: The UNIX operating system evolved at Bell Laboratories to be a machine independent. This operating system has gained a devout following among computer professionals. With the increasing availability of 16-bit microprocessors, UNIX will soon be found in large numbers in the micro world. Many of the military systems that are currently developed or being developed (including many of those that use the Apple II) have plans to upgrade to the Motorola M68000 (a 16-bit microprocessor) and thus would make UNIX accessible. Once users have UNIX on their system, a wealth of professional software becomes available from the minicomputer environment. UNIX could well be the microcomputer standard operating system of the future.

TACCS: The Tactical Management Information Systems (TACMIS) of the US Army Computer Systems Command at Fort Monmouth, NJ, has recently awarded a development contract to three vendors for the Tactical Army CSS Computer System (TACCS). TACCS will be a 16-bit microcomputer that will be ready to take to the field early next year and will be able to communicate directly with many existing battlefield automated systems. The original intent of TACCS was to replace the Division Level Data Entry Device (DLDED), and its planned application is data and record management in the following areas: personnel (SIDPERS), supply (DLSA), maintenance (SAMS), ammunition (SAAS), transportation (DAMMS), and medical (TAMMIS). With a significant cost savings, TACCS could very well be used to replace those battlefield automated systems it must interface with. The enthusiasm that has greeted TACCS throughout the Army has led TACMIS to expect that 4000 to 12000 systems will be delivered with the first buy instead of the originally planned 2500 to 6000 systems. These numbers could certainly grow as TACCS becomes a standard item in the Army inventory. With this type of proliferation, TACCS could well become the standard military computer family for microcomputer applications.

System bus: When it comes time for the addition of peripherals to a computer — such as printers, monitors, and disk drives — there are two general approaches taken by computer manufacturers. One is to implement "convenient" connectors on the computer housing for each of the peripherals that may be needed. The problem with this solution is that the computer is thus limited in its flexibility and expandability by the number and type of connectors that the vendor chose to include in the design of their product. This is sometimes made worse by the fact that the connectors will only accommodate devices made by the same company that manufacturers the computer itself. A second approach is to have a system bus with several generic connectors. A bus is a collection of several signal lines which are used to transfer and route data, instructions, and control signals to all of the devices within the computer system. Each connector has the same set of signals available; thus any device may be plugged into any connector. Such is the case with the Apple II's 8 "expansion ports." This gives users increased flexibility because they can choose from a variety of peripherals which have been manufactured by numerous companies to interface with the particular bus structure of the Apple II microcomputer. Users may select any combination of peripherals that they wish. Going with the bus structure of a specific vendor has obvious drawbacks in versatility. There is, however, a popular bus standard which is not owned by any one company, yet there are a great number of computer systems built around this bus. This standard is the IEEE 696 or S-100 bus which was formally adopted by the Institute of Electrical and Electronics Engineers (IEEE) Standards Board in December 1982. Buying or building a computer system around an industry standard such as the IEEE 696 carries with it the advantages of flexibility since hundreds of companies market computer components that are S-100 bus compatible. Since the protocol between any two devices is defined in the standard, a user may replace any device, board, or even the CPU without having to alter any other part of the computer. The IEEE 696 standard also will automatically accommodate either an 8-bit or 16-bit microprocessor or even both at the same time. Virtually every microprocessor is available on an S-100 board which means there is little restriction in the selection of software packages. Since most processors can be used in an S-100 bus environment, so can some operating systems such as CP/M.

Miscellaneous: There are several final considerations to be made in designing a system. The documentation that was described as being so important in selecting a software package is also of extreme importance for the computer itself. Be sure to examine the documentation for clarity and completeness when shopping for a computer. To do this, sit down with the instruction manual while in the computer store and attempt to perform several of the tasks involved in setting up the computer. This will also give you a good idea of how user friendly the computer is. Expandability is a must because you never know what your future requirements may be. This is why a computer with an expansion bus such as the IEEE 696 standard is preferable. Ask about after-sale support of the computer. This should include maintenance (both warranty and non-warranty items) and assistance in learning to use the system. When figuring the cost of the system, do not forget to include the cost of all peripherals, cables, and adaptors; the cost of software; and the cost of the service contract.

Conclusion

A computer can prove to be a tremendous asset in just about any job or office. Choosing the wrong computer, however, may be counterproductive. No advice can replace extensive investigation and a thorough understanding of the product that you are purchasing. It

is recommended that further reading be done before making a decision. There are many good periodicals dealing with computers which are available at any newsstand or computer store. My final piece of advice is to start small because large, complex, expensive computer systems tend to have large, complex, expensive problems.

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Floppy disk terms:

Single Sided (SS): For single head drives. Data is recorded on one side only. One index hole in jacket.

Double Sides (DS): Four dual head drives. Data is recorded on both sides. One index hole in jacket.

Reversible: For single head drives. Data is recorded on both sides by manually flipping the disk over.

Single Density (SD): Data recorded at 3408 bits per inch (bpi).

Double Density (DD): Data recorded at 6816 bpi.

Soft Sector: Disk has one index hole near inside diameter. All sectoring information is recorded in the format.

Hard Sector: Disk has 10 or 16 sector holes in addition to the index hole. Soft sector disks are not interchangeable for hard sector disk.